

# Report on the Analysis of the Asia Pacific Regional Geodetic Project (APRGP) GPS Campaign 2020

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# Executive Summary

The annual Asia Pacific Regional Geodetic Project (APRGP) GPS campaign is an activity of the Geodetic Reference Frame Working Group (WG) of the Regional Committee of United Nations Global Geospatial Information Management for Asia and the Pacific (UN-GGIM-AP). This document describes the data analysis of the APRGP GPS campaign undertaken between the 13<sup>th</sup> and 20<sup>nd</sup> of September 2020. Campaign GPS data collected at 105 sites in twelve countries across the Asia Pacific region were processed using version 5.2 of the Bernese GNSS Software in a regional network together with selected IGS (International GNSS Service) sites. The GPS solution was constrained to the ITRF2014 reference frame by adopting IGS14 coordinates on selected IGS reference sites and using the final IGS earth orientation parameters and satellite ephemerides products. The average of the root mean square repeatability of the station coordinates for the campaign was 1.7 mm, 1.9 mm and 5.5 mm in north, east and up components of station position respectively.

# Introduction

The annual Asia Pacific Regional Geodetic Project (APRGP) GPS campaign is an activity of the Geodetic Reference Frame Working Group (WG) of the Regional Committee of United Nations Global Geospatial Information Management for Asia and the Pacific (UN-GGIM-AP). The WG continues to undertake an annual GPS campaign activity as some member countries are unable to participate in the Asia Pacific Reference Frame (APREF) project but have an ongoing requirement for geodetic positioning relative to a stable global/regional reference network. One of the roles of the WG is to create and maintain a densely realised and accurate geodetic framework, coordinate regional cooperation in geodesy amongst national agencies, and to build and improve the regional geodetic infrastructure. The APRGP is where UN-GGIM-AP member agencies contribute GPS data to the WG. GPS data from the APRGP are available for all participant member countries for local and global scientific research and local applications. The composite GPS data set is subsequently analysed by the WG to provide estimates of station coordinates in the International Terrestrial Reference Frame (ITRF). The results of the APRGP are also supplied by the WG to the official ITRF product centre to densify the ITRF in the Asia Pacific region. This document overviews the data analysis of APRGP GPS campaign undertaken in 2020.

The document is organised as follows. The data set of the campaign is described first. The data processing scheme is detailed thereafter, followed by the results of processing including the repeatability RMS (root mean square) of the station coordinates, and the final computed station coordinates.

# GPS Data Set

The 2020 GPS campaign was undertaken from 13 to 20 September 2020 inclusive (day of year 257 to 263). Data were contributed by twelve countries across the region, including Bangladesh, Brunei, Hong Kong (China), Indonesia, Japan, Korea, Laos, Malaysia, Myanmar, Philippines, Singapore and Tonga. Note that Hong Kong (China), Japan and Philippines are also contributing Continuous GPS (CGPS) data to the APREF project. Figure 1 shows the distribution of the APRGP 2020 campaign stations along with the APREF stations and IGS stations, blue circles are APRGP campaign sites, and black triangles are APREF stations.

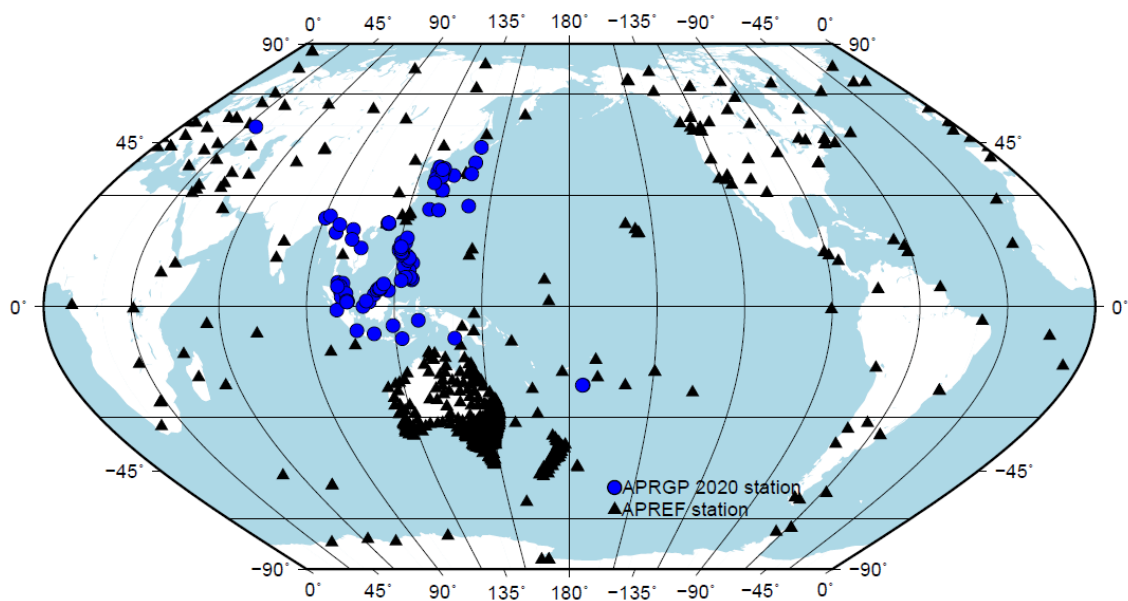


Figure 1 APRGP stations in the APRGP 2020 GPS campaign analysis along with the APREF stations and IGS stations, blue circles are APRGP campaign sites, and black triangles are APREF stations.

# Data Processing Scheme

Analysis of the GPS observations was undertaken using the Bernese GNSS software V5.2. The Bernese GNSS software conforms to the IERS2010 conventions (Gérard and Brian, 2010). In order to tie the APRGP network to the ITRF2014 reference frame (Altamimi et al., 2016), the campaign data was processed along with the available data from IGS sites located around the Asia-Pacific region and APREF stations. For the details of APREF project, see <http://www.ga.gov.au/scientific-topics/positioning-navigation/geodesy/asia-pacific-reference-frame> .

An overview of the processing strategy is as follows:

- IGS final precise GPS satellite ephemeris and Earth rotation parameters were used for the daily data processing to generate daily normal equations.
- Site displacement due to ocean tidal loading for all stations were corrected by using the FES2004 model (Lyard et al., 2006).
- Antenna phase centre variations were taken into consideration using consistent, absolute IGS models of both receiver and satellite antenna phase centres (Schmid et al., 2007).
- Dual frequency carrier phase and code data were used with an elevation cut off angle of 7° and elevation-dependent weighting. Code measurements were only used for receiver clock synchronisation. Pre-processing used a sampling rate of 30 seconds; a sampling rate of three minutes was used for other processing.
- Carrier phase pre-processing was conducted on a baseline by baseline mode using triple differences. The observations with small pieces and the observations suspected to be corrupted by a cycle slip were marked. Subsequent processing did not use the marked observations. Different linear combinations of L1 and L2 cycle slips were fixed if possible. New ambiguity parameters were introduced if cycle slips could not be fixed reliably or if significant gaps in the observations were present. In addition, a data screening step in a baseline by baseline mode was performed based on weighted post-fit residuals and outliers were marked and removed from further processing.
- A priori dry tropospheric delay computed from a standard atmosphere was mapped with the Dry Global Mapping Function (GMF) (Böhm et al., 2006). For the wet component, continuous piecewise linear troposphere parameters were estimated in 1-hour intervals without any a priori model using the wet Vienna Mapping Function (VMF) and the ionosphere-free combination observations.
- After the pre-processing, ionosphere maps were estimated using the geometry-free linear combination. The vertical electron content was modelled with a single-layer model in a solar geomagnetic reference frame. The height of the single layer was 450 km above the Earth's surface. The previously estimated ionosphere maps were introduced as a priori ionosphere information and, in addition, stochastic ionosphere parameters were set up to support the Quasi Ionospheric Free (QIF) ambiguity resolution strategy (Dach et al., 2015).
- Ambiguity resolution was attempted on all baselines within the network in a baseline by baseline model using Melbourne-Wüebbena strategy for baselines up to 6000 km; the QIF approach was used for baselines up to 2000 km; and the phase-based wide-lane/narrow-lane method for baselines up to 200 km; and direct L1/L2 method for baselines up to 20 km. The QIF strategy is based on the ionospheric free linear combination, but also incorporates the estimation of an ionospheric parameter for each epoch to account for the residual ionospheric biases, details can be found in Dach et al. (2015).

- The daily normal equations were generated and combined into a campaign solution. As part of this process the daily solutions were compared with the combined solution and the resulting differences were analysed for the presence of outliers and the daily repeatability.



## Results

The daily repeatability root mean square (RMS) of the station coordinates, an estimate of the day-to-day scatter of coordinate components about a weighted epoch mean, was used to assess the quality of the final epoch solution and as a measure of internal precision. Table 1 lists the daily repeatability (RMS) of the station coordinates. The average of the repeatability (i.e. RMS) of the station coordinates for the campaign was 1.7 mm, 1.9 mm and 5.5 mm in north, east and up components, respectively.

*Table 1 Daily repeatability RMS for the APRGP 2020 GPS campaign stations.*

Station	Country	North (mm)	East (mm)	Up (mm)
DHAK	Bangladesh	1.2	1.9	7.5
MAUL	Bangladesh	1.2	1.6	9.1
KBEL	Brunei	2.1	2.9	9.3
LAMU	Brunei	1.8	1.4	10.5
LIAN	Brunei	3.2	2.0	7.8
MURA	Brunei	1.2	1.2	5.8
TEMB	Brunei	1.8	1.8	3.4
TUTO	Brunei	2.4	4.6	5.6
UKUR	Brunei	1.5	2.2	8.7
HKKT	Hong Kong (China)	1.3	2.9	5.5
HKLT	Hong Kong (China)	1.4	2.3	10.3
HKQT	Hong Kong (China)	3.2	2.0	9.5
HKSC	Hong Kong (China)	2.8	3.1	9.2
HKSL	Hong Kong (China)	1.7	3.0	4.9
HKST	Hong Kong (China)	3.7	3.2	9.3
KYC1	Hong Kong (China)	2.0	2.3	9.1
T430	Hong Kong (China)	2.4	2.8	8.5
BAKO	Indonesia	1.5	2.6	12.8
CAMB	Indonesia	2.1	1.1	5.1
CMAK	Indonesia	2.5	2.1	11.1
CMRE	Indonesia	1.7	2.7	6.8
CPDG	Indonesia	1.6	3.5	5.9
CPON	Indonesia	2.2	3.5	8.7
CSBY	Indonesia	1.0	1.8	6.4
CUKE	Indonesia	0.9	2.9	8.4
0029	Japan	1.3	1.8	7.8
0745	Japan	3.2	1.4	5.2

Station	Country	North (mm)	East (mm)	Up (mm)
0746	Japan	2.4	2.2	3.3
0837	Japan	2.2	2.9	8.7
1135	Japan	1.3	1.9	6.1
2004	Japan	2.1	4.4	11.6
2005	Japan	1.6	1.5	5.2
2007	Japan	1.7	2.4	5.5
3009	Japan	2.0	2.5	5.8
BOEN	Korea	1.3	1.8	4.7
CHNG	Korea	1.2	2.7	4.6
CHSG	Korea	3.1	5.1	8.2
CHYG	Korea	1.4	1.6	4.6
DOND	Korea	1.6	1.6	3.5
DONH	Korea	2.2	2.5	6.8
JAHG	Korea	1.7	1.5	4.6
ODXY	Laos	2.6	2.8	7.0
SLVN	Laos	3.2	2.3	12.7
VTNE	Laos	2.3	2.6	9.1
1233	Myanmar	1.0	3.5	5.0
POL1	Myanmar	1.7	2.0	5.4
PBAY	Philippines	2.1	1.7	4.4
PBGU	Philippines	2.7	2.1	11.5
PBOG	Philippines	1.2	1.1	5.1
PBOR	Philippines	1.5	1.1	8.6
PCB2	Philippines	2.3	3.7	8.3
PCDN	Philippines	1.3	1.3	4.9
PCEB	Philippines	2.2	2.1	9.2
PCRT	Philippines	1.0	1.7	7.2
PDAV	Philippines	1.9	2.1	8.2
PDDN	Philippines	1.8	1.7	7.7
PDUM	Philippines	1.2	1.2	8.2
PGUI	Philippines	2.4	1.3	9.9
PGUM	Philippines	2.0	2.0	5.6
PILC	Philippines	1.5	1.1	9.6
PILN	Philippines	1.5	1.6	5.1
PLEG	Philippines	1.7	1.4	9.2
PMAS	Philippines	1.5	2.0	6.6

Station	Country	North (mm)	East (mm)	Up (mm)
PMRM	Philippines	1.2	1.4	6.0
PMSC	Philippines	1.6	2.0	6.5
PNAG	Philippines	2.0	1.0	10.3
PPAG	Philippines	0.9	1.5	7.3
PSJN	Philippines	1.4	1.0	7.7
PSNR	Philippines	1.9	1.2	10.5
PSRF	Philippines	1.2	1.9	8.8
PSRG	Philippines	1.4	1.8	6.2
PSTC	Philippines	1.8	1.2	3.8
PSTN	Philippines	1.7	3.0	6.1
PTAG	Philippines	1.3	1.4	10.1
PTLC	Philippines	1.0	2.2	4.5
PURD	Philippines	1.4	2.1	7.7
PZAM	Philippines	1.8	2.5	5.7
SLYG	Singapore	1.5	2.2	3.0
SNPT	Singapore	2.2	2.2	10.0
SNSC	Singapore	3.0	5.3	11.1
SNUS	Singapore	2.7	2.5	11.4
SNYU	Singapore	1.2	2.0	4.7
SRPT	Singapore	1.4	2.2	4.7
SSMK	Singapore	0.9	1.3	2.5
T002	Tonga	2.3	1.5	7.9
TGPU	Tonga	2.0	3.0	6.7

The final computed Cartesian and geodetic coordinates (ITRF2014, GRS80 ellipsoid) are listed in Table 2 and Table 3, respectively, along with their formal error estimates. These estimates provide an indication of the quality of the measurements; they only characterise the internal precision of positioning performance and should not be taken as realistic estimates of position accuracy. More realistic estimates of station positioning uncertainty are provided by the RMS statistics given in Table 1. Note that the listed coordinates are at the mean epoch of the measurements in the ITRF2014 reference frame, and only for the campaign sites, the weekly coordinates of other CGPS stations of APREF project can be found in <http://www.ga.gov.au/scientific-topics/positioning-navigation/geodesy/asia-pacific-reference-frame> . The solutions in Solution Independent Exchange (SINEX) format can be found in the ftp link: <ftp://ftp.ga.gov.au/geodesy-outgoing/apref/APRGP/>.

Table 2 The final computed Cartesian coordinates in ITRF2014 at the mean epoch of the measurements, i.e. @2020. 710 (in decimal year).

Station	X (m)	1 std (m)	Y (m)	1 std (m)	Z (m)	1 std (m)
0029	-3862399.0534	0.0006	3105008.3723	0.0005	4001960.9396	0.0006
0745	-3512920.2559	0.0005	4524558.0613	0.0006	2795881.7504	0.0004
0746	-3786804.7792	0.0004	4311846.2318	0.0005	2774485.6388	0.0003
0837	-3530185.8681	0.0010	4118797.1826	0.0010	3344036.6822	0.0009
1135	-3591931.2117	0.0003	3758796.8278	0.0004	3682342.7605	0.0003
2004	-3565271.9778	0.0006	4118973.0000	0.0006	3306292.9644	0.0006
2005	-3642161.4646	0.0005	2861487.8656	0.0004	4370351.2200	0.0005
2007	-4490605.1013	0.0006	3483895.0361	0.0004	2884928.3225	0.0003
3009	-3997616.4175	0.0004	3276761.9037	0.0003	3724230.1801	0.0003
AMAN	-2332692.0347	0.0004	5934768.0221	0.0008	135097.2191	0.0002
ARAU	-1131052.0089	0.0004	6236311.6773	0.0010	711747.9488	0.0003
BAKO	-1836969.4839	0.0004	6065616.9426	0.0010	-716257.9340	0.0003
BEHR	-1270756.8617	0.0003	6236377.8873	0.0008	416063.8539	0.0002
BIN1	-2497850.2984	0.0006	5857731.5890	0.0011	358111.8489	0.0003
BOEN	-3141805.4466	0.0005	4060585.3054	0.0007	3772022.9738	0.0005
CAMB	-3934881.7127	0.0004	5003055.9910	0.0005	-408361.9288	0.0002
CHNG	-3233224.8151	0.0006	4067916.1378	0.0006	3686211.9891	0.0005
CHSG	-3237146.2727	0.0005	3989513.4475	0.0005	3767338.4202	0.0005
CHYG	-3076700.8769	0.0005	4112486.3074	0.0007	3769348.4919	0.0005
CMAK	-3119382.0991	0.0006	5534200.5568	0.0009	-567039.5487	0.0003
CMRE	-3362412.6061	0.0010	5335364.2036	0.0013	-950458.6059	0.0004
CPDG	-1147179.6600	0.0003	6273233.4993	0.0010	-105481.0695	0.0002
CPON	-2111129.6789	0.0005	6018657.1004	0.0012	-399.8374	0.0003
CSBY	-2443857.7063	0.0004	5835257.9562	0.0010	-808826.4731	0.0003
CUKE	-4860592.8008	0.0010	4021866.1361	0.0009	-935407.9171	0.0004
DHAK	-40573.4564	0.0002	5840711.2295	0.0005	2553577.2425	0.0003
DOND	-3036947.2098	0.0004	4021287.4414	0.0005	3896957.3559	0.0004
DONH	-3196657.1997	0.0004	3930091.7148	0.0005	3862221.5867	0.0004
GET2	-1329700.5552	0.0003	6199778.6909	0.0008	687105.4481	0.0002
GRIK	-1225760.8767	0.0003	6230325.9204	0.0008	600544.0596	0.0002
HKKT	-2405144.5760	0.0004	5385195.0247	0.0008	2420032.3099	0.0004

Station	X (m)	1 std (m)	Y (m)	1 std (m)	Z (m)	1 std (m)
HKLT	-2399063.4105	0.0004	5389237.6189	0.0008	2417326.8262	0.0004
HKQT	-2421568.5679	0.0006	5384910.3366	0.0011	2404264.1671	0.0005
HKSC	-2414267.5959	0.0005	5386768.7580	0.0008	2407459.7991	0.0004
HKSL	-2393383.0940	0.0004	5393860.9435	0.0007	2412592.1786	0.0003
HKST	-2417143.5534	0.0005	5382345.2550	0.0008	2415036.7156	0.0004
JAHG	-3152833.9777	0.0005	4199245.1876	0.0007	3608372.2445	0.0005
JHJY	-1520490.3735	0.0003	6191944.3956	0.0008	169912.6523	0.0002
KBEL	-2607322.5418	0.0006	5798828.0467	0.0012	505057.4068	0.0003
KUAL	-1443668.6265	0.0003	6184650.1180	0.0008	587309.8352	0.0002
KYC1	-2408855.9287	0.0005	5391042.9976	0.0008	2403590.8988	0.0004
LAB1	-2708735.6205	0.0005	5744698.4091	0.0008	583318.7272	0.0003
LAMU	-2657634.7699	0.0006	5774933.8996	0.0013	516639.2047	0.0003
LIAN	-2638655.3581	0.0005	5783351.4528	0.0012	519610.0331	0.0003
MAUL	-193340.6931	0.0003	5808683.2553	0.0010	2618404.6164	0.0005
MIRI	-2586925.5450	0.0006	5809853.2574	0.0010	482986.8376	0.0003
MTAW	-2974552.8973	0.0008	5622305.9547	0.0012	470932.3513	0.0003
MURA	-2691871.4626	0.0006	5755365.3937	0.0014	555841.9331	0.0003
ODXY	-1241451.4265	0.0003	5839373.8137	0.0007	2239496.3735	0.0003
PBAY	-3164088.0067	0.0004	5236293.6844	0.0007	1797982.2462	0.0003
PBGU	-3117582.2874	0.0009	5267799.2671	0.0013	1791560.5134	0.0004
PBOG	-3499087.8729	0.0003	5191752.5201	0.0004	1214049.9977	0.0002
PBOR	-3622661.8624	0.0006	5089865.7433	0.0008	1280634.6195	0.0003
PCB2	-3161494.9485	0.0009	5274362.8719	0.0014	1687745.6262	0.0005
PCDN	-3088458.5452	0.0004	5255341.0910	0.0006	1870978.2350	0.0003
PCEB	-3499372.6101	0.0004	5209601.9268	0.0005	1134905.1140	0.0002
PCRT	-3504293.6358	0.0005	5220264.5468	0.0007	1068957.8891	0.0003
PDAV	-3688320.1806	0.0008	5143554.7190	0.0011	786028.7197	0.0004
PDDN	-3698127.3267	0.0004	5130740.7622	0.0006	822545.2952	0.0002
PDIC	-1304198.0828	0.0003	6237114.2854	0.0008	279242.7001	0.0002
PDUM	-3455857.4351	0.0005	5261024.5535	0.0007	1026318.8268	0.0003
PEKN	-1474284.9238	0.0003	6193341.5252	0.0008	385958.5818	0.0002
PGUI	-3557988.3727	0.0006	5182509.8904	0.0008	1075470.8603	0.0003
PGUM	-3290583.7413	0.0004	5245375.6900	0.0007	1524427.5332	0.0003

Station	X (m)	1 std (m)	Y (m)	1 std (m)	Z (m)	1 std (m)
PILC	-3372134.9775	0.0005	5282116.0328	0.0007	1183263.5709	0.0003
PILN	-3219618.7615	0.0004	5178601.7098	0.0007	1864088.4187	0.0003
PLEG	-3449311.3111	0.0006	5166215.7421	0.0009	1442826.2719	0.0003
PMAS	-3450753.0196	0.0005	5188376.7577	0.0007	1357309.2573	0.0003
PMRM	-3629757.1511	0.0004	5172535.2750	0.0005	866088.2717	0.0002
PMSC	-3068374.5285	0.0003	5325915.1722	0.0005	1697541.4208	0.0002
PNAG	-3394666.2566	0.0003	5187872.3803	0.0005	1492904.8898	0.0002
POL1	-666918.1048	0.0003	5878675.9643	0.0010	2377399.8405	0.0004
PPAG	-3484300.2348	0.0004	5271749.5340	0.0006	863058.1081	0.0002
PSJN	-3228520.3568	0.0005	5287794.8336	0.0007	1510623.8155	0.0003
PSNR	-3088262.2444	0.0005	5332020.3649	0.0007	1641797.3341	0.0003
PSRF	-3167388.7660	0.0004	5286533.9209	0.0007	1638185.5806	0.0003
PSRG	-3478357.2085	0.0005	5152038.4657	0.0008	1423144.4166	0.0003
PSTC	-3222394.2248	0.0004	5276124.9596	0.0006	1563214.8304	0.0003
PSTN	-3219843.9994	0.0005	5124937.7484	0.0007	2005414.5265	0.0003
PTAG	-3184318.5888	0.0005	5291065.5797	0.0007	1590418.2807	0.0003
PTLC	-3128650.4593	0.0003	5292970.9427	0.0004	1690799.4412	0.0002
PURD	-3119484.9282	0.0005	5279888.9450	0.0007	1747197.1204	0.0003
PUSN	-3287592.6989	0.0006	4049011.8785	0.0006	3659187.8751	0.0006
PZAM	-3361516.1849	0.0006	5365985.9657	0.0011	764311.8856	0.0004
SLVN	-1735929.3314	0.0004	5891047.6556	0.0009	1716105.5635	0.0004
SLYG	-1539524.8049	0.0003	6187725.8841	0.0008	151763.8599	0.0002
SNPT	-1526243.6881	0.0009	6191001.8485	0.0020	152481.6803	0.0004
SNSC	-1538473.1049	0.0004	6188107.9675	0.0013	145243.1369	0.0003
SNUS	-1518383.3039	0.0003	6193172.5916	0.0010	142897.1387	0.0002
SNYU	-1508025.8992	0.0003	6195576.1137	0.0008	148798.1962	0.0002
SRPT	-1519249.6295	0.0003	6192544.7163	0.0008	159624.0050	0.0002
SSAN	-3198236.0294	0.0003	4258919.8118	0.0004	3497381.4366	0.0003
SSMK	-1518411.3949	0.0002	6193330.4787	0.0004	133831.2748	0.0001
T002	-5928866.3930	0.0011	-515401.5091	0.0003	-2286709.3934	0.0005
T430	-2411015.9048	0.0005	5380265.4865	0.0009	2425132.4646	0.0004
TEMB	-2693843.1540	0.0006	5757787.7712	0.0012	520314.5162	0.0003
TGPU	-5930281.6784	0.0008	-486624.4481	0.0003	-2289338.5527	0.0004

Station	X (m)	1 std (m)	Y (m)	1 std (m)	Z (m)	1 std (m)
TUTO	-2651866.3787	0.0006	5776287.7918	0.0014	530901.0072	0.0003
UKUR	-2678449.2831	0.0006	5762777.5290	0.0012	543962.3528	0.0003
UMAS	-2225109.3559	0.0003	5975252.5359	0.0008	162341.0557	0.0002
UMSS	-2791752.3760	0.0008	5695647.4601	0.0012	666580.5392	0.0003
USMP	-1135919.7606	0.0003	6248058.4257	0.0010	591589.4301	0.0002
VTNE	-1314798.2548	0.0004	5923043.4641	0.0013	1961129.3656	0.0006
YOWL	-3164687.4408	0.0006	3984003.8590	0.0006	3833703.7941	0.0006

Table 3 The final computed Geodetic coordinates in ITRF2014 at the mean epoch of the measurements, i.e. @2020. 710 (in decimal year).

Station	LONGITUDE (DMS)			1 std (m)	LATITUDE (DMS)			1 std (m)	ELLIPSOID HEIGHT (m)	1 std (m)
0029	141	12	14.27876	0.0002	39	6	38.18328	0.0003	172.3034	0.0009
0745	127	49	34.27066	0.0002	26	10	6.97442	0.0002	97.1342	0.0008
0746	131	17	26.38974	0.0002	25	57	13.43463	0.0002	72.5786	0.0006
0837	130	35	58.54851	0.0004	31	49	26.61195	0.0004	314.6191	0.0016
1135	133	41	58.47818	0.0002	35	29	25.43601	0.0002	72.4500	0.0006
1233	96	3	50.94580	0.0002	19	49	40.13639	0.0002	92.4700	0.0008
2004	130	52	42.89057	0.0002	31	25	31.10485	0.0003	134.5335	0.0010
2005	141	50	41.35278	0.0002	43	31	43.11256	0.0003	118.6003	0.0007
2007	142	11	42.08718	0.0002	27	4	3.11854	0.0002	104.2046	0.0007
3009	140	39	33.29718	0.0002	35	57	19.62510	0.0002	65.8143	0.0005
AMAN	111	27	27.25675	0.0003	1	13	18.69129	0.0002	52.2310	0.0009
ARAU	100	16	47.06283	0.0003	6	27	0.56404	0.0003	18.0032	0.0011
BAKO	106	50	56.09033	0.0003	-6	-29	-27.80012	0.0002	158.1213	0.0011
BEHR	101	31	1.97362	0.0003	3	45	55.32895	0.0002	68.6992	0.0008
BIN1	113	5	39.62250	0.0003	3	14	25.13937	0.0003	58.9730	0.0013
BOEN	127	43	48.98300	0.0002	36	29	18.12032	0.0003	212.2544	0.0009
CAMB	128	11	5.62593	0.0002	-3	-41	-44.01666	0.0002	87.4133	0.0006
CHNG	128	28	41.03889	0.0002	35	31	59.91456	0.0003	61.7816	0.0009
CHSG	129	3	22.86636	0.0002	36	26	8.25595	0.0003	250.0320	0.0008
CHYG	126	48	5.40417	0.0002	36	27	32.04117	0.0003	136.4808	0.0010
CMAK	119	24	28.86246	0.0003	-5	-8	-5.29081	0.0003	77.5843	0.0010
CMRE	122	13	10.69753	0.0004	-8	-37	-38.98392	0.0003	59.4138	0.0016

Station	LONGITUDE (DMS)			1 std (m)	LATITUDE (DMS)			1 std (m)	ELLIPSOID HEIGHT (m)	1 std (m)
CPDG	100	21	47.21052	0.0003	0	-57	-14.33234	0.0003	3.8695	0.0010
CPON	109	19	44.56556	0.0003	0	0	-13.01755	0.0003	36.8746	0.0012
CSBY	112	43	27.72181	0.0003	-7	-20	-3.60743	0.0003	51.2312	0.0010
CUKE	140	23	38.98823	0.0003	-8	-29	-23.46969	0.0003	80.1856	0.0013
DHAK	90	23	52.82919	0.0002	23	45	22.20892	0.0002	-29.3318	0.0005
DOND	127	3	38.68615	0.0002	37	54	7.38356	0.0002	140.4532	0.0007
DONH	129	7	27.15457	0.0002	37	30	25.14098	0.0002	69.9612	0.0007
GET2	102	6	18.54900	0.0003	6	13	33.49479	0.0002	1.8420	0.0009
GRIK	101	7	49.00152	0.0003	5	26	20.44027	0.0002	149.1752	0.0009
HKKT	114	3	59.65925	0.0003	22	26	41.65404	0.0002	34.5479	0.0009
HKLT	113	59	47.86920	0.0003	22	25	5.27508	0.0002	125.8985	0.0009
HKQT	114	12	47.60240	0.0003	22	17	27.71861	0.0003	5.1577	0.0013
HKSC	114	8	28.30150	0.0003	22	19	19.81167	0.0002	20.2131	0.0010
HKSL	113	55	40.75795	0.0002	22	22	19.20956	0.0002	95.2680	0.0008
HKST	114	11	3.29516	0.0003	22	23	42.96658	0.0002	258.6910	0.0009
JAHG	126	53	58.47675	0.0002	34	40	31.25004	0.0003	116.7957	0.0010
JHJY	103	47	47.52615	0.0003	1	32	12.51324	0.0002	39.1699	0.0008
KBEL	114	12	36.27474	0.0004	4	34	20.27741	0.0003	55.5067	0.0013
KUAL	103	8	20.93861	0.0003	5	19	7.99752	0.0002	55.0386	0.0009
KYC1	114	4	34.72905	0.0003	22	17	2.58187	0.0003	116.3450	0.0010
LAB1	115	14	41.19986	0.0003	5	16	57.50528	0.0002	57.2880	0.0009
LAMU	114	42	43.09490	0.0004	4	40	38.49912	0.0003	75.8407	0.0014
LIAN	114	31	29.47152	0.0003	4	42	15.56569	0.0003	65.7500	0.0013
MAUL	91	54	22.94320	0.0003	24	23	49.89284	0.0003	-15.7318	0.0011
MIRI	114	0	6.28775	0.0003	4	22	19.55765	0.0003	62.3606	0.0011
MTAW	117	52	53.94509	0.0003	4	15	45.97995	0.0003	72.8677	0.0014
MURA	115	3	58.33150	0.0004	5	1	59.35963	0.0003	63.7853	0.0015
ODXY	102	0	8.59113	0.0002	20	41	22.43549	0.0002	626.9663	0.0008
PBAY	121	8	34.55320	0.0002	16	28	53.59330	0.0002	322.8888	0.0008
PBGU	120	37	4.22953	0.0004	16	25	4.06584	0.0004	1545.1179	0.0015
PBOG	123	58	43.70360	0.0002	11	2	46.67669	0.0002	88.5285	0.0005
PBOR	125	26	27.54767	0.0003	11	39	37.02033	0.0002	67.3012	0.0010



Station	LONGITUDE (DMS)			1 std (m)	LATITUDE (DMS)			1 std (m)	ELLIPSOID HEIGHT (m)	1 std (m)
PCB2	120	56	19.70409	0.0004	15	26	45.80182	0.0004	78.7718	0.0016
PCDN	120	26	30.83859	0.0002	17	10	16.93071	0.0002	55.3402	0.0007
PCEB	123	53	23.59227	0.0002	10	19	5.18757	0.0002	126.9394	0.0006
PCRT	123	52	22.55760	0.0002	9	42	45.87538	0.0002	76.5216	0.0008
PDAV	125	38	36.25087	0.0003	7	7	35.36389	0.0003	96.7622	0.0014
PDDN	125	46	59.70123	0.0002	7	27	33.75718	0.0002	90.5755	0.0007
PDIC	101	48	37.92927	0.0002	2	31	34.23098	0.0002	31.1738	0.0008
PDUM	123	18	0.28044	0.0002	9	19	18.62548	0.0002	88.3892	0.0008
PEKN	103	23	22.89983	0.0003	3	29	33.34734	0.0002	25.9996	0.0008
PGUI	124	28	15.83818	0.0003	9	46	20.73232	0.0003	116.8839	0.0010
PGUM	122	6	4.67789	0.0002	13	55	12.67012	0.0002	64.0324	0.0008
PILC	122	33	15.86979	0.0002	10	45	46.38415	0.0002	75.3445	0.0008
PILN	121	52	11.53794	0.0002	17	6	21.79792	0.0002	115.4582	0.0008
PLEG	123	43	47.01090	0.0003	13	9	40.39491	0.0003	210.0220	0.0011
PMAS	123	37	39.36108	0.0003	12	22	8.03393	0.0002	80.1601	0.0009
PMRM	125	3	31.47452	0.0002	7	51	22.60395	0.0002	375.5302	0.0007
PMSC	119	56	49.81843	0.0002	15	32	16.70385	0.0002	57.2757	0.0005
PNAG	123	11	54.92494	0.0002	13	37	36.53179	0.0002	73.1266	0.0006
POL1	96	28	20.50173	0.0003	22	1	31.24652	0.0003	1026.4656	0.0011
PPAG	123	27	44.05001	0.0002	7	49	44.39084	0.0002	74.3918	0.0007
PSJN	121	24	23.77384	0.0002	13	47	30.03934	0.0002	66.6242	0.0008
PSNR	120	4	44.64847	0.0002	15	0	56.59565	0.0002	65.6828	0.0008
PSRF	120	55	39.46773	0.0002	14	58	54.90057	0.0002	70.4873	0.0008
PSRG	124	1	29.77081	0.0003	12	58	44.01369	0.0002	64.8536	0.0009
PSTC	121	24	52.22187	0.0002	14	16	53.93878	0.0002	62.4702	0.0008
PSTN	122	8	23.67200	0.0002	18	26	49.98626	0.0002	42.4970	0.0009
PTAG	121	2	26.74939	0.0003	14	32	7.59155	0.0002	86.6560	0.0009
PTLC	120	35	13.68863	0.0002	15	28	28.58147	0.0002	112.3207	0.0005
PURD	120	34	32.20221	0.0002	16	0	15.10642	0.0002	82.5514	0.0009
PUSN	129	4	29.46265	0.0002	35	14	2.16940	0.0003	158.7077	0.0010
PZAM	122	3	54.15302	0.0003	6	55	43.13764	0.0003	84.2317	0.0012
SLVN	106	25	7.65084	0.0003	15	42	42.83047	0.0003	166.7595	0.0010

Station	LONGITUDE (DMS)			1 std (m)	LATITUDE (DMS)			1 std (m)	ELLIPSOID HEIGHT (m)	1 std (m)
SLYG	103	58	18.03692	0.0002	1	22	21.44548	0.0002	50.4961	0.0008
SNPT	103	50	55.53812	0.0005	1	22	44.81880	0.0004	54.8317	0.0021
SNSC	103	57	42.03919	0.0003	1	18	49.11967	0.0003	14.5703	0.0013
SNUS	103	46	31.86049	0.0003	1	17	32.68574	0.0002	62.7315	0.0011
SNYU	103	40	47.94439	0.0002	1	20	44.84643	0.0002	75.5720	0.0008
SRPT	103	47	3.91586	0.0002	1	26	37.41755	0.0002	58.7514	0.0008
SSAN	126	54	16.98944	0.0002	33	28	4.09022	0.0002	46.3872	0.0006
SSMK	103	46	31.52690	0.0002	1	12	37.48571	0.0001	24.7337	0.0004
T002	-175	-1	-54.18489	0.0003	-21	-8	-52.90552	0.0003	58.3595	0.0012
T430	114	8	17.54189	0.0003	22	29	40.98780	0.0003	41.2975	0.0010
TEMB	115	4	22.98276	0.0003	4	42	38.57920	0.0003	65.1525	0.0013
TGPU	-175	-18	-32.24958	0.0003	-21	-10	-24.51188	0.0002	63.1361	0.0009
TUTO	114	39	34.67245	0.0004	4	48	24.37110	0.0003	79.9426	0.0015
UKUR	114	55	41.77752	0.0003	4	55	31.13002	0.0003	74.7096	0.0013
UMAS	110	25	28.92639	0.0002	1	28	5.91074	0.0002	51.3593	0.0008
UMSS	116	6	43.32089	0.0004	6	2	21.23333	0.0003	76.3435	0.0015
USMP	100	18	14.54367	0.0003	5	21	28.03067	0.0002	19.8274	0.0011
VTNE	102	30	56.12994	0.0003	18	1	31.84531	0.0003	192.4228	0.0014
YOWL	128	27	42.54998	0.0003	37	10	57.05976	0.0003	253.5861	0.0009

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